

Submerged Cultural Resource Management: A Three Phase Process

An Honors Thesis (HONRS 499)

By

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A handwritten signature in black ink, reading "E. J. Bowers-Bienkowski". The signature is written in a cursive style with a large, stylized "E" and "J".

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Abstract

This examination of Submerged Cultural Resource Management (SCRM) is divided into four sections. The first section explains the background of SCRM. Underwater archaeology plays a major part in the SCRM process and therefore, its background is important to know. The background section explains how underwater archaeology came to be and how it eventually became incorporated into Submerged Cultural Resource Management. The last three sections deal with the three-phase process of SCRM. The background search, testing, and mitigation phases are all explained using both the example of an underwater archaeology field school as well as generic, theoretical examples. All four sections link together to show just how important Submerged Cultural Resource Management is to preserving our world's maritime and terrestrial history.

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Introduction

Where did people come from? This may quite possibly be the most thought about question in the world, second perhaps only to 'Why did the chicken cross the road?' Not only is this question thought about, but also it is studied, researched, and theorized. There is an answer out there somewhere and some of us humans are dead set on finding it. In fact, there is a scientific field dedicated simply to the study of humans. This field is anthropology. One of the social sciences, anthropology studies humans through their cultures. Culture is an ambiguous word with many definitions. In relation to anthropology, culture is simply a system of meanings invented, taught, and learned by humans influencing their behaviors and lives as a whole. Anthropology studies every aspect of this system of meanings. In the United States there are four branches of anthropology that work together to accomplish this: physical anthropology, cultural anthropology, linguistics, and archaeology.

Anthropology

Physical anthropology deals with the physical aspects of humans. It measures all parts and functions of the human body to discover how they function and why. This includes the measuring of bones at different ages, including the brain case and skull. With this information they look for patterns and developmental stages. Physical anthropologists can see how nutrition, maturation and hormone releases cause the human body to change and grow and how this differs in different places. They also see how diseases and illnesses affect human bones and muscles. Moreover physical anthropology

studies evolution and the primate origins of humans. By studying the same aspects of primate bodies as of human bodies, they can see how closely related humans are to primates. This includes studying ancient primates and seeing how they evolved from one to another. This aids their attempt to develop an evolutionary answer to our age-old question as well as providing clues on how humans developed their culture.

Cultural anthropology deals with the actual culture of people. In the beginning of the field, scientists thought that humanity progressed through a succession of evolutionary stages. They found peoples around the world still using stone tools and living “primitively.” These models have since been rejected. It is true that there are cultures around the world that still use stone tools and do not have running water and electricity. However, it is no longer thought that they are “primitive” or less “evolved” than western cultures. This is due to cultural anthropologists. Cultural anthropologists study people by living amongst them. This technique, called participant observation, allows the anthropologist to live with the people and fully experience their traditions and ways of life, as well as their thoughts and feelings on a day-to-day basis. Ethnographies are written to describe the cultures of people and share them with the rest of humanity. Ethnologies compare different cultures. In this way we learn about the world around us and attempt to answer our question through the knowledge and culture of all of mankind.

Linguistics is perhaps the most specialized branch of anthropology. Just as the name suggests, linguistics deals with the language aspect of culture.

There are some people who believe that the language of a people is their culture. Others think it is merely a window to it, but also a very important aspect of it. Many of the world's languages are either extinct, or very close to it. As the world grows and changes, cultures grow and change. This leaves behind many languages that are no longer being used. In a way, this means losing important aspects of cultures around the world. Linguists work hard to record and capture these languages so that knowledge can be gained from them. Another aspect of linguistics mirrors the work of physical anthropologists. Since language is such an important part of culture, it is important to see how it develops. Linguists study the physical substrates of language, how language develops in children, how they learn it, and how they use it. They also study how languages develop within cultures, how new languages are born and develop, as well as how older languages are phased out and become extinct. Their contribution to the answer to our question is through language.

Last, but certainly not least, is archaeology, the fourth branch of anthropology. This is the branch that will be examined in this paper. Although a branch of anthropology, archaeology itself has many branches. These branches will be discussed later. Archaeology itself is the study of material culture. Most often, this is used synonymously with artifacts. This, in fact, is not correct. Material culture is anything made, used, or manipulated by humans. This includes artifacts, but is not artifacts exclusively. Material culture also includes features in the ground such as garbage pits or storage areas, and other such things. Archaeologists study all material culture to pull together an idea of what a

culture was like. Unlike cultural anthropologists who study a modern culture and how it works firsthand, archaeologists must use what has been left behind by humans to pull together their system of meanings, or culture and attempt to fill in all of the holes. Unfortunately, the holes will never fully be filled in and answering one question leads to many more. However, what archaeologists do discover speaks volumes about cultures that make up our past and have brought us to what we are now. Their contribution to the answer is through the cultures that came before us and how they relate both to each other, as well as how they relate to us.

As mentioned above, archaeology has its own branches. Because archaeology deals with all material culture, it also deals with all aspects of human life. The Earth is seventy-five percent water. As humans developed the need to travel and trade with other cultures, they also developed the need to travel on water. Even though humans require water to live, they are not at home in the water. To adapt to this, they built vehicles to take them across it. The water is its own world, dangerous and unyielding. As soon as humans put boats on the water, nature, and accidents put him beneath it. Even though cultures developed and built bigger and better ships, nature, and of course human error, caused them to sink. Shipwrecks are not the only means of material culture, however. Civilizations that were built on the seaside thousands of years ago have since been flooded as the oceans expanded. In addition, humans sometimes had to expand out onto bodies of water in order to best utilize what little land they had; such as the crannogs in Ireland and Scotland and the dykes built by the Dutch.

All of this has caused material culture to be found under water. In order to best study the history of humans, archaeologists could not just stick to terrestrial sites. Instead, they had to expand to the water, as their ancestors once did. This time, however they were not sailing across the top, they were looking at the bottom. This has developed the field now known as underwater archaeology. This field is very closely related to, if not synonymous, to the fields known as nautical or maritime archaeology. These fields are, however, considered to deal more with material remains that are ships and anything pertaining to the water, rather than the recovery of materials from under the water. Though these may be slightly different, they must depend on underwater archaeology to recover most of the material culture they seek to study.

SCUBA

Although it only makes sense that this field came into being, it was more accidental than it sounds. However, in order to understand how the field developed, one must understand its major component, diving. Now known as scuba diving, its origins lie with skin diving. Skin diving is basically what most people know as snorkeling. Modern skin divers use a facemask, snorkel, and fins to dive deep for short periods of time. Most times there is a guide rope used to both pull themselves down as well as to help in surfacing. Skin diving is believed to go back to the ancient Greeks and Romans. A relief found in the ruins of a palace of Ashur-nasir-pal at Ninevah shows a swimmer making use of what appears to be an underwater breathing device. Whether it is truly this, or a means of establishing buoyancy by breathing into the device, either way, the

man is using methods similar to modern diving techniques (Cleator 35). It is believed that skin divers were used both to retrieve precious items from the sea floor (such as pearls) as well as setting up for warfare in a harbor. Whatever the reason, people were trained in this technology. Skin diving persisted to more modern times to recover things like pearls and sponges from the sea floor.

Although skin diving was a wonderful asset to any culture, it was difficult to make it efficient. Although divers trained themselves to hold their breath for long periods of time, no one can hold it indefinitely. In order to make diving easier and to allow people to stay under longer, methods were attempted to permit breathing while underwater. As early as the fifteenth century, men were experimenting with such devices. Leonardo da Vinci described one such device in his *Codex Atlanticus*. It consisted of a long tube extending from the diver's mouth to the surface where it is attached to a round float to keep it on this surface (Cleator 26). This idea was perpetuated by other so-called "armchair" divers such as Vegetius in 1511, Vallo in 1524, Lorini in 1597, and Robert Fludd in 1617 (Cleator 27). These scientists are called "armchair" divers because it is clear that they did not dive, instead they merely studied and theorized about it. Had they actually been divers and used these devices they would have learned that they never would have worked. It wasn't until the seventeenth century that doubts began to appear about these breathing devices. If the diver were to attempt to breath through such a tube, he would be working against gravity. Would it be possible for a diver to pull air down that far? In 1681, Jean de Hautefeuille proved that these devices were impossible in *The Art of Breathing Underwater*.

In this, he proved that divers could only pull air down a short distance just over a foot or two feet. The answer to this problem would be to provide air at the same pressure as the water surrounding the diver. Robert Boyle, a scientist of the time, investigated the situation. He developed a principle, now known as Boyle's Law, relating to the behavior of gases. Basically, this law states that the volume of a gas relates inversely to pressure. That is, as the pressure doubles, the volume of the gas is halved, and vice versa. Therefore, it would be imperative to pressurize the air for the diver to breath (Cleator 27-30).

In 1616, Franz Kessler developed the diving bell. It was discovered that if an object were lowered into the water with the bottom open, it would trap air inside that would increase in pressure as it was lowered. The air inside the bell would then be the same pressure as the water surrounding it at any depth. This was a bell shaped apparatus that would be worn by a man. It had view ports at eye level and would allow the diver to walk around the sea floor. It used ballast as a buoyancy compensator. By the end of the century, Edmund Halley, of the comet, had developed a more advanced version. It allowed the diver to leave the bell and breathe from a tube attached to the inside of the bell (Cleator 31). However, these diving bells would not allow much freedom of movement for the diver. In the early eighteenth century, a design for a rigid diving outfit was developed. Two approaches developed here: one was to have a rigid suit that was filled with air at the pressure of the area around the diver; the other was to have a rigid suit that was sealed and kept at regular atmospheric pressure, like a miniature submarine. The materials they had available would not allow for

movement as they were not built to withstand such high pressures, and therefore would not work (Cleator 31).

In the late eighteenth and early nineteenth centuries, attention turned more toward a flexible diving outfit. In 1797 K. H. Klingert developed a flexible diving suit. It was made from leather and covered the majority of the diver's body. The diver then wore a dome shaped helmet that connected to the suit at the diver's shoulders. It used two air tubes attached to a float on the surface. This allowed the diver to make only shallow dives. In 1802, William Forder designed a suit in an attempt to fix this problem. It was a full body suit inflated by bellows. Although the idea of the suit should have worked, it was never implemented adequately. In 1816, Augustus Liebe decided to focus on the helmet, instead of the suit. His helmet was metal with a glass plate in the front for the diver to see out. Air was accessed through two pipes. The first, and longer pipe extended to the surface where air was pumped into the helmet. The second, and shorter of the two pipes extended out and allowed the air to escape. Liebe attached his helmet to a waterproof jacket developed in 1819. Called 'andopen' dress, it extended to the diver's waist and was open at the bottom. Shadowing the idea of the diving bell, the open bottom allowed the pressurized air pumped into the helmet to escape freely. This design required the diver to remain in a vertical position in order to keep the water from flooding in. Although it allowed the diver to walk around on the sea floor, it was not conducive to swimming and therefore limited the diver's movement. In 1837 Liebe developed a closed suit like those modern divers wear. It allowed divers to move

horizontally without water flooding the suit. For safety, the closed dress was fitted with two non-return inlet and outlet valves. One served in case of damage to the air supply line, or its pump, by keeping the pressurized air in the suit. The other allowed an open flow of exhaled air so that the diver would not be endangered by a back flow of water (Cleator 32-33).

Although many advances were made in the area of the diving suit, the helmet still needed work. Back in 1825 (before Liebe's closed suit), William James worked with the idea of the diver carrying compressed air with him rather than breathing air pumped down from the surface. His initial design incorporated a waterproof suit and copper helmet. The diver would then carry compressed air in a cylinder worn in a belt-like manner. The air, compressed to 30 atmospheres, or 441 pounds per square inch (psi), entered the helmet through a tube. (A measure of pressure, the atmosphere is equal to 14.7 psi.) In 1860, and said to be inspired by James, Benoit Rouquayrol and Auguste Denayrouze began work on a diving device they called the aerophore. One of its many forms consisted of a close fitting suit, vulcanized rubber hood, facemask, and cylinder of air. The snout like facemask was made of metal connected to the air tank by a conical valve. This valve kept the air at the correct pressure for the diver. Kept in a closed state by the pressure of the air coming from the tank, the valve was opened by pressure on its tail shaft. The tail shaft connected to a rubber membrane of a compensation chamber. From this chamber, a feed tube connected to a mouthpiece held in the diver's teeth. The membrane, and therefore the valve, was activated by the inhalation of the diver as well as an

increase in pressure around the diver. This allowed the diver to remain equalized in pressure. When the diver exhaled or surfaced, excess air escaped out a flutter valve. This apparatus was documented in old French Navy manuals as working successfully up to 50 meters in depth (164 feet) in 1865 (Cleator 40-42).

Around the year 1912, a man named Maurice Fernez developed diving equipment very much like that we use today. It consisted of a pair of detachable goggles, a nose clip, a weighted belt, and a U-shaped tube that went in front of the face. Attached to the tube in the middle of the U was a rubber nozzle. The nozzle, when held by the diver's teeth, was the source of air for the diver. The two ends of the tube went behind the diver's back. There, one end terminated in a duck's beak valve. The other end led to an air-line with atmospheric connections down which a constant flow of air was pumped to the diver. The excess, and exhaled air, escaped through the duck's beak valve. In 1925, Yves Le Prieur noticed Fernez's equipment at an exhibition in Paris. Le Prieur wanted to adapt the equipment so that it could be used with much more freedom of movement. In conjunction with Fernez, Le Prieur removed the air-line and attached a cylinder of air, carried on the diver's back and compressed to 150 atmospheres. After testing in 1926, and subsequent testing, the two adapted their equipment for the comfort of the diver. Instead of detachable goggles, nose clip, and mouthpiece, they introduced a full facemask. The compressed air was pumped into the mask through a Rouquayrol-Denayrouze-like demand valve while a spring operated regulating device made sure that the air pressure in the

mask was slightly above the surrounding water pressure. This allowed excess air and exhaled air to escape around the edges of the mask. In 1934 a safety feature was added that limited the content of the air cylinder to 150 atmospheres in order to avoid decompression sickness (Cleator 43-45).

Jacques Yves Cousteau, an officer in the French navy, is probably the most well known inventor when it comes to the development of diving. A love of swimming and for the sea kept him attempting to produce mechanisms that would make the diver's job easier. Cousteau, and his fellow sea lovers, wanted to develop a device that would not only allow them to stay under water longer, but that would also help them to dive deeper. For more than a year Cousteau attempted to develop a closed circuit oxygen device, but kept falling prey to convulsions and unconsciousness at 45 feet in depth. After nearly drowning during one such trial, he decided that rather than using pure oxygen, regular air must be used to breath underwater, as Le Prieur had. However, Le Prieur's device required a constant flow of air controlled by a hand valve. Cousteau wanted to develop something that would automatically release air. In 1942, Cousteau teamed up with Emile Gagnon, an engineer, to attempt to develop such a device. They developed a two-stage process. The first stage reduced the pressure of the air from the 150 atmospheres of the tank to 6 atmospheres. The second stage allowed the air to flow to the diver, as it was required. This kept it at a pressure equal to the surrounding water pressure, therefore keeping the diver equalized. At least, this is what was supposed to happen. When Cousteau tested the equipment, it was discovered that the device only worked

properly when the diver was horizontal. If the diver became vertical at all, there was an excess rush of air. The problem was with the intake and exhaust valves. Only when the diver was horizontal were the two valves under the same pressure. The problem was easily fixed by placing the exhaust valve directly next to the demand regulator valve. The new device did not have a pressure gauge. Instead, the air cylinders were designed so that when only 25 atmospheres remained in the tanks, a spring-loaded valve shut off the diver's air supply. The diver then manipulated a reserve tap and surfaced. The diver also inhaled and exhaled through a mouthpiece separate from the rest of his equipment. He wore separate goggles as eye protection. Cousteau improved upon a facemask developed by Maxime Farjot in 1937. He substituted a single pane of glass for two, thus removing the double vision suffered when the eyepieces were not in the same plane. In 1943 Cousteau's equipment was tested and found to work in all positions, both vertical and horizontal. He named it SCUBA or the Self Contained Underwater Breathing Apparatus (Cleator 49-52). Unfortunately, Cousteau's apparatus was not developed for sport or science. Because of the war, other countries (Italy, Germany, and Britain) were experimenting with underwater breathing equipment. All had small successes, but Cousteau and Gagnon were the first to create an entirely independent device (Vallintine 74)

Underwater Archaeology

Now that we know the origin of diving itself, it is important to know how it was incorporated into archaeology. Terrestrial archaeology began with treasure

hunters. People would pick up artifacts as they found them on the ground. Sooner or later, scientists began to wonder what they could learn from all of these artifacts. Combining this curiosity with anthropology, archaeology was developed. Underwater archaeology began with maritime archaeology. Archaeologists would study shipwrecks that were found on land. In 1863, archaeologists studied a wreck in Scandinavia. A medieval craft believed to be from around the fourth century A.D. and from Nydam, Denmark was systematically excavated by Conrad Engelhardt (Babitt 30). However, underwater archaeology began with divers, not with archaeologists. In 1900, the first underwater wreck was discovered by a troop of sponge divers. In Greece, a group of sponge divers anchored on the north side of Antikythera Island just below the cliffs. The first diver of the day, Stadiatis, donned his rubber suit, copper breastplate, steel soled shoes, copper helmet, and lead weights, tied his guideline around his waist, and jumped into the water. The young boy in charge of helping the divers called out the fathoms as they ticked by. He called out "thirty fathoms" and then began rapidly counting backwards. After only a few short moments at thirty fathoms, Stadiatis was already surfacing. When he reached the top, the diver was scared and agitated, rambling about seeing people in different states of decomposition and disrepair. The leader of the boat, Kondos, decided to see what had so startled his diver. He donned the diving gear and plunged in the same way Stadiatis had. At thirty fathoms, the guideline was tugged three times to signal a requested ascent. When the men on the boat attempted to pull in the line, it was stuck; Kondos had tied it off on something.

When the diver himself surfaced, he ordered the men to pull harder and bring up the object on the other end of his guideline. What they surfaced was a hand, a life size bronze hand. What the sponge divers had found was a shipload of bronze statues. Working with the local university and the Greek government, the wreck was "salvaged" and most of the statues were recovered. Although more resembling a treasure hunting operation, this is considered the earliest underwater archaeological operation (Throckmorton 115-128). Other, more scientific excavations were soon to follow. In 1907 the Society of Antiquities of London hired a certified diver to help in an underwater excavation. They investigated a site in Herne Bay, Kent, and recovered Roman pottery. In 1908 an amateur archaeologist, and priest, named Odo Blundell attempted his own underwater study. From Fort Augustus, Scotland, Blundell dove and studied a crannog in Loch Ness. Crannogs were artificial islands built in the lochs of Ireland and Scotland. Ancient peoples lived, worked, and stored livestock and goods on these islands to free up the land around the lochs. So little of the land was fertile that they had to use every bit they could. The crannogs became their homes and the lochs their roadways. The land around the lochs was used for farming. Blundell had so much success with his diving in 1908 that he continued diving on crannogs in the 1909 season (Babits 30). Even though archaeologists were consulted on these studies, they were not the ones diving. This jeopardized sites. The divers, not trained in archaeological methods, not only missed important information, but also most often destroyed the site by

swimming over it, or disturbing it. Although it opened the world of underwater archaeology a little bit, the advantages were limited.

In 1944 Jacques Yves Cousteau founded the Undersea Research Group of the French Navy. Later, with the support of the French Navy, he pulled his own research group out of the Undersea Research Group and named them the National Geographic Society. He gathered biologists, geologists, and oceanographers and taught them how to dive with his SCUBA equipment. He then took them on expeditions (Throckmorton 174). This put trained scientists under water and on the site. This meant that the sites being studied would be studied more thoroughly and were less likely to be damaged. By 1952 Cousteau was independent and determined to make an experimental under water excavation. Gaston Christiannini, an independent diver who suffered from the bends, discovered the perfect wreck. He was treated by Cousteau's Undersea Research Group where he informed Cousteau of the wreck. The wreck itself was 100 feet long and ranged from 125 to 245 feet deep. Teams of divers worked on excavating the wreck and were kept to strict decompression tables, in order to avoid diving illnesses such as the "bends" and embolism. The divers recovered thousands of pieces, including amphorae, believed to date to the second century BC. However, the excavation was soon stopped by the mud of the sea floor. The massive suction created by the mud made it near impossible to remove artifacts as well as causing diminished visibility. Out of necessity comes the greatest of inventions, and this was no exception. Cousteau and his crew developed what is now known as the airlift. A similar mechanism had been used

at the turn of the century to pump water out of mines and mud from harbors. In this case, the airlift consisted of a long tube. Air was injected into the bottom of the pipe, which then rose to the surface (since its density is lower than that of water) creating suction. This suction pulled the mud up and away from the site. The major problem with this excavation, however, was that it did not follow Cousteau's breakthrough idea with the National Geographic Society; none of the divers were trained in archaeology. The supervising archaeologists remained on the deck of the ship. This continued to be the major problem of underwater archaeology; no one trained in the science was there to inspect and study the wreck site. Divers worked for five years on the wreck now known as The Grand Congloue. The Congloue was most important in that it was the developing grounds for equipment to be later used by underwater archaeologists: the airlift, under water photography, and others. In 1961 the first archaeological report on the site was published (Throckmorton 175-178).

By 1958, the same problem with underwater archaeology began to come to light over and over. Although a great deal of timber and artifacts were being recovered and studied by archaeologists on the surface, they were not being studied in situ, and a great deal of material was being left on the bottom. In order to attempt a solution to this, a man named Taillez decided to map the wreck site. In order to do this he tried underwater photography of wreck sites. He then attempted to make a mosaic from these photos. Regular photos do not work for mapping without special lenses and without being taken in a special way. The traditional way to map a site on land was to use triangulation, or use a few

definite sites to measure from and use angles to map the site. A scientist named Lamboglia decided that photogrammetry (Taillez's method) was too theoretical and that triangulation was too time consuming. He then tried mapping a site by placing a taped grid over a wreck. He first tried this on a Roman wreck in 1958. Over the next few years Lamboglia improved upon his design. It had a fair amount of success, but there were still some kinks to work out (Throckmorton 192-194).

In 1960 a young American archaeologist from the University of Pennsylvania Museum lead an expedition to Turkey to work on the oldest shipwreck ever found (dating to 1200 BC). This young American was George F. Bass. Bass had a great deal of experience in land excavations, but never considered becoming a diver until this excavation. He had prepared himself by taking diving lessons at a Philadelphia YMCA and made his first sea dive on this wreck in Turkey. Bass turned out to be a revolutionary thinker in the field of underwater archaeology. He had two ideas that proved very alarming to professional divers. The first is "An archaeologist was the only person who should direct an archaeological excavation, never mind where the excavation took place." The second is "If anything could be done on land, it could be done just as well under water" (Throckmorton 195). His ideas worked on the basis that it took years to train someone as an archaeologist, but only days to teach someone to dive (Throckmorton 192-195).

The Gelidonya, or Turkey, wreck attempted to incorporate methods developed by Cousteau, Taillez, and Lamboglia. However, they had difficulties

adapting them to this particular wreck. For example, Lamboglia's frame was near impossible to set up due to a rocky bottom. In 1962, Bass improved upon the grid. He built a steel grid like Lamboglia's using two meter squares. The squares were stepped down the wreck to accommodate for rocky or sloping surfaces. He then built two portable towers that held cameras. The cameras were directly over the square and therefore photographed each square from the same angle. These towers could also be moved from frame to frame. The archaeologists also dug into the wreck photographing it as they went. The next step was to improve on stereo photogrammetry. In the 1963 season, Bass, Don Rosencrantz, and architect Julian Whittlesey attempted to copy the terrestrial mapping method. This method uses a camera attached to the front of a plane. The plane flies over the area while the camera snaps pictures at set intervals. The photographs are then put together to create one larger picture. Bass, Rosencrantz, and Whittlesey mimicked this method. They set up a 'T' shaped apparatus. Two lift bags were used at each end with a bar in between them. The bar is leveled and a camera attached to it. The camera then passes along the bar, above the site, and takes pictures of the site at set intervals. The method was tested in the summer of 1963 on the wreck, and as a surprise to everyone, it worked. It was shown up in the summer of 1964, however. The Electric Boat Company built a submarine, which they christened the Ashera. This sub accommodated two men in depths up to 600 feet. It used viewing portholes, a Fathometer to record its depth, gyrocompass, floodlights, and two waterproof aerial cameras for stereo photogrammetry. They found that this sub

could do a job in one day that it took Bass, Rosencrantz, and Whittley's 'T' setup, with twenty people working on it, three months to do (Throckmorton 201-206). The field of underwater archaeology was truly developing and growing. Now trained archaeologists were using and developing methods and equipment to make this field just as scientific as its terrestrial counterpart. Just as George Bass said, "if anything can be done on land, it can be done just as well under water."

Cultural Resource Management

All of the excavations and projects discussed so far have been developed with research in mind. A great many archaeological projects and excavations are done for research purposes. However, there is another side of archaeology that has been rapidly growing in recent history. Applied archaeology has been out there as long as research archaeology has been. Archaeologists were taking what they were learning in the field and adapting it to modern cultures. Not only were they adapting it, but they were using what they learned from the past to help improve and understand the cultures of today. In effect, they were applying their research. Another aspect of this came, again, out of necessity. Although archaeologists were studying many of the world's sites, these were merely a fraction of what is out there. Because archaeology is a relatively new field, in the realm of scientific study, archaeologists seem to be fighting a losing battle. Many of the world's archaeological sites are destroyed not just by treasure hunters and grave robbers, but also by construction and technological advancement. In 1966 the US government passed the National Historic Preservation Act in an attempt

to protect historical sites. This act requires that “national government agencies survey, inventory, and assess the historical significance of heritage resources including underwater cultural heritage prior to undertaking any action, such as issuing permits, expanding funds, developing projects and taking other government actions” (Dromgoole 220). Section 106 of this act sets up parameters for the surveying, inventory, and assessment of historical sites. Section 110 requires the national government agencies to manage historical sites under their jurisdiction and control. This includes the assessment and determination of these sites for nomination to the National Register of historic sites (Dromgoole 220-221).

The passing of the National Historic Preservation Act in 1966 caused an uprise of public and private applied archaeology agencies. These agencies are better known as Cultural Resource Management agencies. Cultural Resource Management (CRM) refers to the surveying, inventory, and assessment of sites prior to any work done by federal agencies. The CRM agencies are hired to go out and follow the guidelines set up by Section 106 of the National Historic Preservation Act. Section 106 sets up a process done in concordance with the State Historical Preservation Office, or SHPO requiring the CRM agency to study the background of a site, survey the site, and determine if any further testing is required from the site, if it is “historically significant” so to speak. The CRM agency then submits a report to the SHPO, and they decide whether or not to follow through on the CRM agency’s recommendations. If further testing is agreed upon, the CRM agency then goes out and excavates the area. This

process, set up by Section 106, mimics the three phase process of applied archaeology. Phase one is the background check and surveying of the area. The background check includes studying any known records of the history of the area to be studied. On land, the survey includes walking across the area to search for artifacts, and perhaps even digging a few holes to see what can be found. All of this is done in a systematic manner. Phase two is the testing phase. This is when excavation is done. A research design is developed and followed so that excavation is done in a systematic manner as well. Finally, phase three is the mitigation phase. In this phase, reports are written; artifacts are studied, and eventually curated. Although not all of the world's historic sites can be excavated, studied, or preserved, the National Historic Preservation Act and Section 106 do a great deal to save what they can (www.state.in.us/dnr/historic/pdf/plan1.pdf).

As is stated above in the requirements of the National Historic Preservation Act, land sites are not the only sites required to be surveyed. Underwater historic sites are also required to be surveyed. Although most CRM agencies concentrate on the land aspect of Cultural Resource Management, there are some who focus on what is known as Submerged Cultural Resource Management (SCRM). Just like their terrestrial counterparts, SCRM agencies follow the Section 106 guidelines to study, preserve, and protect underwater historical sites. Other legislations have been passed regarding the abandonment and study of shipwrecks. However, Submerged CRM goes beyond that. They deal with sites that may have originally been on land, but were flooded due to the

expanding of the oceans or flooding of caves and mines. The survey and assessment of these resources is done in much the same way, as are terrestrial resources. Submerged Cultural Resources also follows a three phase process; background check and survey, testing, and mitigation.

In order to better explain and explore the three phase process of submerged cultural resources, it is useful to apply theory to practice. For this purpose, each phase of the archaeological process will be explained through the underwater/nautical archaeology field school that I have personally taken part in. The set up of this school perfectly demonstrates how the three phase process works. However, since it is in effect, a school, some of the phases are adapted. Therefore, I will be using information gained from the instructor and crew chiefs of the school on how they accomplish(ed) each phase. This will demonstrate how theory is put into practice.

MATC Field School

The Marine Archaeology Techniques Course (MATC) is a program (field school) put on by the University of Hawaii at Manoa. It is an annual summer field school and has been going on for about ten years. Each year it is held in a different location. Students are brought in for a month to learn the methods and equipment usage of underwater archaeology and then to apply what they have learned. This year's field school (2001) focused on an eight mile stretch of beach on the north side of Lana'i Island known as Shipwreck Beach. Lana'i Island is a sparsely inhabited island between Maui and Moloka'i. Consisting of only about 2500 residents, the island's population resides in Lanai City. Residents of Lana'i,

and of Hawaii as a whole, are very protective of their heritage and history.

Therefore, the trip to Lana'i to study Shipwreck Beach was both welcomed and cautioned. Shipwreck Beach got its name due to the great number of shipwrecks its beaches have claimed. On the windward side of the island, many ships have been blown up on the shallow reefs over the decades by currents and winds. In addition to this, Shipwreck Beach is believed to have been the site of at least one landing used when the island produced cattle. All of this makes Shipwreck Beach an ideal spot for the MATC field school.

The objective of MATC 2001 was to go to Shipwreck Beach and apply the Maritime Cultural Landscape method. Produced by Christer Westerdahl and other anthropologists and social scientists, this method suggests that archaeologists (anthropologists, biologists, etc.) focus not only on the material culture found in the water (i.e. ship wreckage), but also study the maritime culture surrounding it. That is, they suggest studying fishing spots, towns, landings (piers and harbors), and the people that existed, and still exist around the material culture. For our field school, this meant a lot of surveying. Because we were the first people to study Shipwreck Beach in this manner, there was a great deal of information to sort through and record. We focused mainly on the wreckage found in the water and on the beach, but also incorporated the fishing shelters, dry riverbeds, and prehistoric "keiki" pool (or pool for small children) that were found. This allowed our field school to get a well rounded idea of the maritime culture of Lana'i and Hawai'i.

Phase I

Before going any further, each of the three phases must be explained. The first phase of the archaeological process is the background phase. Using this model, this is the phase when the researcher, or archaeologist, gathers the information needed to properly study a site. According to the Indiana Division of Historical Preservation and Archaeology, Phase I includes a substantial background search on the site. Mainly, this entails an archival search to learn about the site. This will allow the archaeologist to get an idea of the possible contents of the site. Archival research can find deeds to the land, any known historical sites in the area, and what the land the site incorporates may have been used for historically. Beyond this, the archaeologist should look into other aspects of the land within the site. This would be the physical aspect of the site. Soil makeup and biological inhabitants are important to know. The consistency of the soil will indicate what type of equipment will be needed to use in order to dig, should the need arise. In addition, knowing the soil can suggest what type of artifact preservation you might find. Certain types of soil erode easily and, therefore, are not as likely to hold artifacts. The flora and fauna are also important to know about. In reference to plant life, this can tell you what kind of visibility you may have while surveying. Animal life of the area can tell you what type of obstacles you may encounter and what kind of natural traces may be encountered. Safety of the crew is a key factor in any archaeological operation. Walking surveys (or swimming as the case may be) are also useful to get the lay of the land where you will be working. Archival and book research is nothing

without actually seeing the area you are dealing with. Knowing the area you will be working in is key to the success and safety of your team (van Tilburg 2001).

Although this phase seems to deal more with land based, or terrestrial, archaeology, it also applies to underwater archaeology, especially where safety comes into play. Most times when working in underwater archaeology, you are dealing with shipwrecks. Archival research on an area may be able to tell you the types or even names of ships that went down in your site area. If you are working on a site not dealing with ships, you may be able to determine for what the site was used. For example, if the site is a Scottish loch, an archival search may be able to determine whether or not a crannog (artificial island built on stilts in the lochs of Scotland and Ireland) lies within your site. And of course, archival research will help in determining if any other sites have been recorded in the area, and what type of site it was. This again will give you clues to what you may find. As far as the biological aspect applies to underwater archaeology, it is imperative. There are many dangers working underwater, and a great deal of them deal with the biologics. Not only is SCUBA diving and snorkeling potentially dangerous when waves and currents are mixing you with wreckage, but many plants and animals are poisonous or carnivorous. Being aware of what you might encounter is not simply helpful, but truly necessary (van Tilburg 2001).

Many archaeologists feel that Phase I is the most important phase in the archaeological process. For the MATC field school, it was definitely the most important step. As far as the students of the course were concerned, without the background knowledge we were given, we would have been completely clueless

about the work we were doing. The first week of the month long field school was spent orienting us. We spent some long days in the classroom cramming for the field work in which we were about to participate. The first step was to give us background knowledge about the island of Lana'i itself. Because Hawai'ians are so protective of their history and culture, it was imperative that we know where we were going and that we become familiar with the culture. Lana'i has only been inhabited since the 1400's. Once a heavily populated island, it progressed through several stages of industrialization, the most recent being pineapple plantations. This created a very close knit atmosphere and culture on Lana'i. Archaeologists marching in there must know about the people they are dealing with in order to avoid cultural insults and aggressions (van Tilburg 2001).

After learning about Lana'i, we learned a great deal about the types of ships we would be seeing. Most of the ships that wrecked on Shipwreck Beach were inter-island ships run by steam engines. Both metal and wooden hulls are represented, but steam power seems to be the major source of propulsion. This meant we would be dealing with large metal objects on the sea floor and wooden timbers that washed up on the shore. We were taught how the parts of the ships were constructed and how they fit together. We also examined the timeline along which certain ship technologies were developed. This would allow us to position a possible shipwreck somewhere in the timeline of the island once a piece of wreckage was identified. Although there are a great many parts that go into the construction of a ship, only certain ones survive the deterioration that

takes place in water. Knowing what each of these pieces is is imperative to studying them (van Tilburg 2001).

Finally, we learned about the equipment we would be using in the field. Since we were the first team out there, we focused on the surveying aspect. No excavation was done, as there was no time to do it. The volume of wreckage on Shipwreck Beach is unbelievable. Teams were literally tripping over the wreckage that lined the beach. In order to satisfactorily survey the site, we learned how to use underwater slates, paper, and measuring tools. In addition, we were taught how to use electronic surveying tools known as Electronic Distance Measurement (EDM) and Theodolite. The Theodolite measures the angle from a specified "zero" point and the EDM gives a distance measurement through the use of a laser. Together they give the position of objects in relation to the shoreline and allow the site to be mapped. Handheld Global Positioning Systems (GPS) were used to determine longitude and latitude of specific sites within the survey area. After learning how to use all of the equipment, we were as prepared as we could be for our upcoming field work (van Tilburg 2001).

The background study and work done by the students was only possible because of the background study and work done by the instructors and crew chiefs. Each crew chief has obtained their masters degree, or masters certificate, in either maritime or underwater archaeology. This knowledge was imperative to help us students in learning about ship construction and archaeological methods. Each crew chief was there as a reference should a student need help or instruction on how to deal with certain situations. The

instructor of the field school did a great deal of background as well. A maritime archaeologist himself, he has lived in Hawai'i for some time. When asked about why he chose Shipwreck Beach as a research area, he explained that it was something that needed to be done ever since he came to the islands. He had heard about it from a colleague and just had not gotten to it. In preparation for the field school, the instructor, Hans van Tilburg, did extensive archival research. This produced several possible wreck names as well as recorded history of the area. Beyond that, van Tilburg visited the island several times. On one trip he performed a walking survey of the beach to see where wreckage existed and what types of wreckage there were. Another visit included an aerial survey of Shipwreck Beach. This provided aerial photographs of wreckage both on the beach and in the water. A third trip provided liaison with the locals. This helped in getting our school a place to camp while we were there as well as access to food, water, and transportation. As you can plainly see, this background work was vital to our work (van Tilburg 2001).

Phase II

Phase II begins with finding your site. In Cultural Resource Management on land, the sites are already known. When you apply these methods to Submerged Cultural Resources and underwater archaeology, you remove this certainty. A lot of times, researchers and archaeologists have a fairly good idea of the area in which a site lays, but aren't sure of its exact whereabouts. Even when people are trying to preserve an underwater site, they still may not know where it is. They may just know it is in the general area of the body of water.

This makes surveying the site difficult. In order to find a site, certain tools are used. The major tool used for finding a site is a magnetometer. Many shipwrecks are found by their iron content. The magnetometer consists of a "sled" pulled behind the boat with a reader onboard. The sled consists of a copper coil surrounded by a hydrocarbon solution. It is activated by an electrical pulse sent out to find any magnetic forces on the seabed. Similar to the magnetometer in usage is the side scan sonar. This equipment also incorporates a sled-type object pulled behind the boat and is attached to a computer onboard. The tow fish, as the "sled" is called is dragged behind the boat just above the sea floor. It sends out sonar waves and produces an aerial photo like image of the sea floor. Although it does not penetrate the sea floor like the magnetometer does, it provides a contour of the sea floor to determine if anything significant is laying on it. Other equipment used to locate sites include a Fathometer to determine depth and, of course, video and still cameras (van Tilburg 2001).

The second part of Phase II of the archaeological process is testing. Phase II, as it applies to the MATC course, refers to the time we actually spent on Lana'i doing fieldwork. This is the ten day period we used to survey and record sites on Shipwreck Beach. Due to choppy water conditions, the first two days were spent surveying the land portions of the area. One team set up the surveying equipment close to camp and started plotting in sites up and down the beach in order to later produce an accurate map of the area we were studying. Another team was sent approximately 4 miles up the beach to survey part of the

area we were referring to Shipwreck Beach. The north shore of Lanai is littered with wreckage. Our area of study covered 8 miles of this. The team sent up the beach was my team. We were driven several miles up the beach and dropped off when we ran out of manageable road. From there, we walked an additional two hours up the beach (East). After a short break, we headed back down the beach. This time we spent much more time examining wreckage we came across. We recorded GPS coordinates, took overview pictures, and recorded brief descriptions. On our walk back to camp, we recorded upwards of nine sites each containing a great deal of wreckage on the beach. On the second day out of the water, we returned to one of these sites to record and to study it further (van Tilburg 2001).

Recording a site takes a great deal of work. For all of our water, and land, sites we followed relatively the same methods. We started off by getting an overall view of the site. For land sites this meant walking around the wreckage to view it from all angles and get a feel for all of it. For water sites, the same thing was accomplished by snorkeling over the sites. From there the team working the site would put together plan view drawings of the artifacts in the site. We tried to have both an overall drawing to show where artifacts were in relation to each other as well as detailed drawings of some of the artifacts. Once this was accomplished, the measuring began. Detailed measurements were taken of the dimensions of each object. This is important, as it would help us in recreating our drawings in Phase III. In addition to the dimensional measurements, we had to take trilateration measurements. Trilateration is a method used to position the

objects within a site. This meant that we had to set down a set baseline, or an incremented line (usually a tape measure), in such a way that measurements were easily taken to each object. Once the baseline is set, two points were arbitrarily determined on each object. Then, from each point, two measurements were taken from the baseline to the point, in effect creating a triangle. These triangles then allowed objects to be plotted on a map with baseline set in it (later in Phase III). If a baseline is not feasible, a long, straight object may be used and a similar method known as distance measurements is used. It is essentially the same, only you are measuring against an object rather than a baseline. Once all of this was done, more pictures were taken to backup our measurements and the site was completed (van Tilburg 2001).

The work that the MATC field school accomplished on a site merely scratches the surface of Phase II. This is preliminary to the rest of Phase II. Once objects are drawn, measured, and positioned, excavation would be considered. As mentioned above, this field school did not have time or means for excavation. However, in other archaeological work, excavation would be the next step. For underwater archaeology, grids would be set up over a site. Many methods for this have been developed, but usually PVC pipe or metal bars are set up in a grid formation over the archaeological site. From there, divers use archaeological methods to excavate artifacts. Most of the methods are the same as terrestrial methods. However, sometimes it is necessary to use tools specific to underwater archaeology. These include the mailbox developed by Mel Fisher's team and the dredge. The mailbox uses the propeller of the boat to

push water down to push sand out of the way. This creates craters in the sand. A dredge creates suction by pushing water up the tubing from a separate attachment. This allows sand and debris to be sucked up and out of the way. All of these special tools, including the grids, are used to make excavation under water easier and more efficient (van Tilburg 2001).

Phase III

Finally, there is Phase III, mitigation. This phase includes the conservation of artifacts recovered, analysis of the data recorded, and the creation of a report summarizing everything. Again, our field school did not recover any artifacts so this was not an issue. However, it is an important part of the mitigation process. Artifacts that are recovered from the water have undergone a different type of degradation than terrestrial artifacts have. Therefore, they undergo a different type of conservation. The fact that the artifacts are being reintroduced into a highly oxygenated atmosphere (air) also has to be considered. When objects are underwater, the low oxygen content and temperature of the water preserve them more easily. In addition, the type of soil found on the seabed can be preserving, such as silt and mud. However, water can also be destructive. When iron is exposed to water, even with a low oxygen content, it chemically changes into ferrous oxyhydroxide, or rust. To combat this, and even reverse the process, iron objects removed from water are put into a low amp electrolysis bath. That is, they are placed in an electrolytic solution and a low amp current is passed through the solution. This produces hydrogen back into the water and removes a great deal of rust, as well as concretions, or

biological growths on the object. Stable metals such as copper, bronze, and brass do not rust, and therefore do not require this process. Wood, however, is a totally different story. When in water, wood is subject to several destructive forces. Any wood that is exposed to the open sea is exposed to biologics that may consume it. One example is the terredo worm. This worm simply eats the wood. Certain bacteria are also known to consume wood on the microscopic level. This is what contributes to the major degradation of wood. Once parts of the wood are removed on the microscopic level, it begins to break down on the cellular level. Capillary tension, or the fluid tension in the cells, is lost and it collapses. To combat this during conservation, wood undergoes one of two processes. The first, bulking, strengthens the cell walls to keep the wood from collapsing. This is done by saturating the wood with Polyethylene Glycol (PEG) or a certain type of wax. Impregnation, the second method, is similar to bulking, but uses a different type of wax. Other substances, such as glass and ceramics are impermeable to water and do not need as extensive conservation (van Tilburg).

The next part of Phase III, analysis, was a large part of the MATC field school. After we returned to Oahu, it was time to analyze the data recovered. The first step was to recreate all of the maps we had spent a great deal of time drawing. Using graph paper, rulers, and compasses, we sat down and started drawing. We used the measurements we had taken of the individual pieces to draw them to scale and to detail. Once each individual object was drawn, the positioning came into play. This is a smaller version of trilateration. The first

step was to set down a line on a large sheet of graph paper that was established as the baseline. Then a scale was determined (the same as our specific object drawings) and marked up and down the baseline. From here, we could take the measurements we had taken from our baseline in the field, adapt them to our scale, and use them to plot our objects onto a map. In this manner we created scaled down drawings of each of the sites. When we finished, we had graph paper drawings about 24 inches by 36 inches. We then took mylar paper and ink pens and traced our graph paper drawings. This was to give our maps a finished look. A painstaking process, the "inking," as it is called, is important and precise. The mylar drawings were then taken to a print shop to be shrunk down even further. In the end we had an 8 inch by 11 ½ inch drawing of our sites. Then it was on to the report (van Tilburg 2001).

In other archaeological projects, analysis is not confined to the mapping process. Our field school was constantly under a time crunch. For those who have time to analyze further, it is much more in depth. From the drawings and descriptions created from the data recorded in the field, archaeologists try to put together the big picture of the site. We also, attempted to figure out the story of our sites. For example, Site 1 of our survey area consisted of a large ship still very much intact and sitting in the water. However, no one knows what the ship did or when it wrecked. Part of our job is to hypothesize what the story of the ship is. Archaeological teams would tie in the background information they had gathered, the field work data they collected, and any additional information they would come up with to determine what the purpose or function of the site was.

— This is the major part of analysis. Archaeology's mission is to attempt to fill in the holes in the Earth's history with the clues we gather in the field (van Tilburg).

Finally, there is the report writing. Again, our field school did not get to finish this, as there wasn't time. However, we did draw up a draft report and prepared a presentation for the public. That is, we put together a shorter version of the report. We explained the background information we had, our methods, our results, and our interpretations. Many archaeologists say that for every hour you spend out in the field, you spend two in the lab. I have a feeling that it is even more time consuming than that. We gathered a great deal of information in our time on Lanai, and did not get anywhere near completing the report of our information. We merely scratched the surface. The instructor and crew chiefs will spend months gathering more information and pulling together all of the information we collected. If anything, we simply created more questions to be answered. That is how archaeology works (van Tilburg 2001).

— Specifically to Submerged Cultural Resources, this portion of Phase III is incredibly important. This is the portion of the process where the archaeological team submits what they have found to the regulating bodies of the Historical Preservation Act and Section 106. A report including all the information gathered on the site, including the background information, is submitted to the regulating body. This also includes the team's recommendations. If significant historical material is found, they will most likely recommend further testing and excavation of the site. However, if nothing is found, they may recommend that the construction, or whatever plans to use the site, can go through without any

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impact. The regulating body reviews the report and recommendations and either agrees or disagrees with the archaeological team. This is where the true mitigation comes into play. If the site requires more work, teams must be contracted to do it. In addition, facilities must be contracted for the curation and conservation of any artifacts recovered. All of this is taken care of during this phase. The client is, of course, consulted throughout the process and works with the archaeological team and regulating body to ensure that the site is properly taken care of (van Tilburg).

Conclusion

And so the archaeological process is complete. Each phase is both time consuming, and important. No phase could be taken out or done out of order. They inter-relate and work well together. Underwater archaeology seems to be a mystery to many people. Even in Hawaii where one would think that the water surrounding the islands would be extensively studied, it is not understood. We were the first team to study Shipwreck Beach. So much wreckage and archaeological material has been exposed up and down the beach for so long. Many people know it is there, but either don't have the motivation to study it, or don't care that it is there. In the state of Hawaii as a whole, things are not much different. The majority of the budget for archaeological research goes to terrestrial sites. The waters around Hawaii are littered with shipwrecks, but are not studied because people don't realize how important it is to their history.

Other countries, on the other hand, are realizing just how important their maritime history is. In the United States, it is referred to as Submerged Cultural Resources. Other countries around the world refer to it as Maritime Heritage. The world, outside of the US that is, has taken large steps to protect that heritage. The United Nations Educational, Scientific, and Cultural Organization held a meeting in Paris from October 17 to November 21, 1972 to set guidelines by which to protect this heritage. The result was a Convention Concerning the Protection of World Cultural and Natural Heritage. This convention sets out specific guidelines for what is considered to be cultural heritage, how to set up services for protection, an intergovernmental committee for protection, funds, and a World Heritage List (like our National Register of Historic Sites) (www.unesco.org/whc/world_he.htm 2001). Beyond that, Europe has set up a Common Europe Maritime Heritage Congress. Set up in 1998, this congress is an organization representing members of the European Union to preserve maritime heritage. The objectives of this congress are to represent their members interests, take action on an international level towards protection of maritime heritage, and to establish a permanent network of private organizations dedicated to protecting and conserving maritime heritage (much like our private CRM companies) (www.european-maritime-heritage.org 2001). Beyond that, many other countries have societies, organizations, and associations following laws set up to protect our Maritime Cultural Heritage. Along those same lines, there are many more advances in technology for this field in other countries. France has done extensive work on remote operated submersibles. There is

more demand for it in their country. We should follow their example and work harder toward protecting maritime heritage in the United States.

The waters around Hawaii, and around the world, are full of information yet to be tapped. Earth is covered seventy-five percent by water. It is impossible to think that humans have only conquered it in the most recent of centuries. With the developing technology, it is becoming more and more feasible to study the world's oceans and bodies of water. When shipwrecks and other under water sites are discovered, they are caches of information. They can tell us about trade routes, food supplies, transportation methods, and even more about cultures that roamed the earth thousands of years before recorded history. Many people are too quick to dismiss the water as a foreboding atmosphere that is too dangerous to explore. On the contrary, it is the challenges of the oceans that make it a wonderful place to explore. Humans are constantly on a quest to make sense of his origins, and essentially to find out from whence they came. Why should we simply let myths and legends persist when the oceans may hold the answers? The answers are out there; it is time to find them. Submerged Cultural Resource Management and Underwater Archaeology are merely the first step in a long journey to find these answers. Where did man come from? Perhaps he came from the water, or at least traveled across it when he came...

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